

iron produces a degree of fusibility that causes little practical difficulty but that with amounts in excess of this figure troubles rapidly accumulate, and that in some cases when the percentage of iron in the ash exceeds 15 it is impossible to work the coal in an ordinary furnace. The following softening temperatures afford a classification of coal ashes in respect of the clinkering property:

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| 1. | Readily fusible. | Softening below 2190° F. |
| 2. | Fusible. | " between 2190°-2460° F. |
| 3. | Difficultly fusible. | " " 2460°-2730° F. |
| 4. | Very difficultly fusible. | " ' " |
| 5. | Refractory. | " above 3000° F. |

The ash of coals for use under boilers should have a melting-point over 2550° F. The percentage of ash in a fuel is without influence on its melting-point, but on the other hand the amount of fixed carbon, pointing to a larger or smaller proportion of the total combustible being available for consumption on the grate and there raising the temperature of the ash, will have some effect either towards increasing the tendency to clinker or to lessen it.

Fine Dust.—The non-combustible portion of coal is partly distributed through the mass of the fuel and partly associated with it in the form of stones and shale. Combustion of the carbonaceous matter sets free the former in a very fine state of division, so that it is easily lifted and carried away by the gases passing to the chimney. In the case of water-tube boilers with high consumption of fuel per square foot of grate area, the fine-dust problem is one requiring careful attention. The composition of this dust varies with that of the coal ash and is generally similar to it, but even when the ash is non-clinkering it is possible to have the formation of considerable masses or " nests " of semi-fluxed dust on the surface of boiler tubes towards the chimney end of the furnace, the production of which is explained by the formation of ferrous oxide on the surface of the tubes from the excess air passing through the furnace, and its subsequent union with silicates in the fine dusts that settle upon it.

Pulverized Coal.—The difficulty that attends the

combustion of coal owing to its compact and impenetrable character has already been touched upon. The limitation placed on the rate of combustion owing to the latter being confined to the surface of the fuel results in a lower temperature being attainable than would otherwise be the case. Fuels high in ash are for the same reason difficult to keep alight. Considerations of this kind have led to the development of systems of burning solid fuels by reducing them first to a fine powder whereby the surface area is enormously increased, and introducing the powder into the furnace along with the air required for complete combustion. The air may be previously heated. In Britain the method has been adapted principally to the manufacture of Portland cement, but in America and elsewhere large installations for steam raising have been erected and are stated to give boiler efficiencies of 80 per cent with fuels not previously useable either with mechanical stoking or in gas producers. Bituminous